

Applicants : John P. Biel, Jr. et al  
Serial No. : 09/889,646  
Confirmation : 8649  
Atty. Dkt. : BEN02 P-346  
Page : 2

**Amendments to the Specification:**

Please replace the noted paragraphs with the following amended paragraphs.

Please replace the paragraph beginning at line 16 of page 8 and ending with line 30 of page 8 with the following amended paragraph.

--More specifically, the inner housing 21 is preferably fabricated of metal or other material that is impermeable to gases, and is adapted to contain one or more catalyst substrates 27 and 27'. Exhaust gases from an internal combustion engine flow through the catalytic converter 20, as indicated by the arrows 28, including through the numerous small, catalyst-coated pores or channels that are formed in the catalytic substrates 27 and 27'. The inner housing 21 is enclosed within the outer housing 22, and its sidewall 30 is spaced radially inwardly from the sidewall 31 of the outer housing with the supports 25 and 25' supporting it to maintain a relatively constant gap. The outer housing 22 is also preferably fabricated of metal or other material that is impermeable to gases, even in hot and high-order vacuum environments. The cavity 26 forms an annular space between the inner and outer housings 21 and 22 that is evacuated to form a sufficient vacuum for insulative purposes. The insulating performance of the cavity 26 is variably controlled by a temperature sensitive hydrogen source device [[32 ]]that includes a hydride material, and the vacuum is maintained by a separate vacuum maintenance device [[32' ]]that includes a getter material, which are collectively referenced by the numeral 32 in Fig. 1, as discussed below.--

Applicants : John P. Biel, Jr. et al  
Serial No. : 09/889,646  
Confirmation : 8649  
Atty. Dkt. : BEN02 P-346  
Page : 3

Please replace the paragraph beginning at line 5 of page 12 and ending with line 20 of page 12 with the following amended paragraph.

--The present invention allows for passive activation of a hydride by the exhaust gases flowing through the catalytic converter 20 (Fig. 1). The hydrogen source device 32 (Fig. 2) includes a containment structure 90, which includes parts of ~~inner and outer tubes 46 and~~ 49[']outlet tube section 46 and reinforcement tube 49' for containing the hydride material 91. The containment structure 90 is formed around (and in part by) the outlet tube 46 so that it is coupled to the exhaust stream in such a way as to allow activation of the hydride within a narrow temperature band and without any external control. The hydride material 91 releases hydrogen into the insulating cavity 26 at a rate that is related to the temperature and pressure of cavity 26, such that conductivity is increased as the temperature of the catalytic converter 20 increases. Thus, the arrangement provides an ~~over-temperature~~overtemperature protection mechanism for the catalyst or catalyst substrate 27 and 27' within the vacuum-insulated catalytic converter 20. The hydride material 91 is kept within the annulus section of the containment structure 90 by a fine wire mesh ~~[[42]]~~92 (or porous sintered metal) that allows free flow of hydrogen. The fine wire mesh 92 is held in place by a containment ring 93 that has multiple holes 94 (Fig. 3) so as not to restrict the flow of hydrogen from the hydride to the interior cavity 26 of the catalytic converter 20.--

Applicants : John P. Biel, Jr. et al  
Serial No. : 09/889,646  
Confirmation : 8649  
Atty. Dkt. : BEN02 P-346  
Page : 4

Please replace the paragraph beginning at line 26 of page 12 and ending with line 5 of page 13 with the following amended paragraph.

--This section discusses and proposes the use of a separate getter 96 and hydride 97 in a converter. The getter and hydride perform two different functions in the vacuum space. The getter is intended to act as a vacuum pump through the life of the converter. The hydride stores hydrogen gas that is released with elevated temperature, thereby acting as an overtemperature protection for the catalytic converter. Previous designs have provided the getter and hydride as one and the same component. This invention involves the use of two separate materials for the hydride and getter. There are distinct advantages in using different containers and positions for the hydride and getter. It is noted that the hydride 97 and getter 96 in Fig. 4 are illustrated as being held in separate container 98 and 97', but it is contemplated that they could be mixed and held in the same container, such as container 98 (see Fig. 7). Container 97' is ring-shaped and is supported by a support 97'' that permits flow of gases between the container 97' and the insulation cavity 26A.--

Please replace the paragraph beginning at line 6 of page 13 and ending with line 24 of page 13 with the following amended paragraph.

Applicants : John P. Biel, Jr. et al  
Serial No. : 09/889,646  
Confirmation : 8649  
Atty. Dkt. : BEN02 P-346  
Page : 5

--A getter is used in the vacuum insulation to maintain the vacuum during the life of the part. It does this by reacting with gases present thereby acting as a chemical vacuum pump. Eventually the getter material may completely react with gas and no longer function. The hydride is usually the same type of material as the getter; however, it is charged with hydrogen that is desorbed as a function of temperature. Hydrogen has a very high thermal conductivity so that a small amount of hydrogen in the vacuum space (a few torr pressure) will cause the space to conduct heat and no longer be insulating. The hydride can be consumed by getter-type reactions with other gas species and no longer be reversible. Separating the hydride and getter functions extends the functionality of the hydride preferably over the life of the component. Also, by using a different composition for the getter and hydride, the getter activation and release of hydrogen gas will occur at different temperatures. Specifically, a SAES St707 "ST707" brand material by SAES of Italy will have lower activation and hydrogen release temperatures than a SAES St101 "ST101" brand material by SAES. By using the St707 "ST707" brand material for the getter function (i.e. getter 96), it can be activated as a getter during the latter stages of the vacuum bake-out, and even assist the vacuum bake-out. The SAES St101 "ST101" brand material has a sufficiently high getter activation that will not be reached until the end of the vacuum bake-out, thereby preserving its capacity as a hydride (i.e. hydride 97); and hydride release temperature that will not be reached during bake-out thereby preserving its hydrogen.--

Applicants : John P. Biel, Jr. et al  
Serial No. : 09/889,646  
Confirmation : 8649  
Atty. Dkt. : BEN02 P-346  
Page : 6

Please replace the paragraph beginning at line 25 of page 13 and ending with line 11 of page 14 with the following amended paragraph.

--The getter 96 and hydride 97 are contained in a container 98 attached to the outer wall 31A of the outer housing 22A. The container 98 (Fig. 7) includes a lower cup portion 99 where the getter 96 and hydride 97 are contained, and further includes an annular ring 100 and up flanges 101. A seal layer 102 covers the cup portion 99, holding the getter 96 and hydride 97 in the cup portion 99. The up flanges 101 include lips 102' that frictionally engage the extruded material 103 around the opening 104 in the wall 31A of outer housing 22A (Fig. 12). The container 98 can be extended through the opening 104 from the outside into the cavity 26A, with the lip[[s]] 102' abutting the marginal material or extruded material or extruded neck 103 to hold the container 98 at a selected position. Detents or an inwardly direct crimp or flange is used to secure the porous cap in place. Also, a can-shaped structure can be used (see Fig. 16). Holes 105 (Fig. 6) in the up flanges 101 and also spaces 106 between the up flanges 101 assure that the getter 96 and the hydride 97 are in communication with the insulating cavity 26A. A vacuum detector/seal lid 107 is snapped over the opening 104 and sealed with braze to cover the opening 104. As described below, the lid 107 is flexible, and dimples when exposed to a vacuum, such that it acts as a vacuum indicator to show the presence of a vacuum (or lack of a vacuum) in the vacuum-insulating cavity 26A. It is contemplated that the getter

Applicants : John P. Biel, Jr. et al  
Serial No. : 09/889,646  
Confirmation : 8649  
Atty. Dkt. : BEN02 P-346  
Page : 7

96 and/or the hydride 97 can be placed in the end cavity or hydrogen source device 32 (See Fig. 1), and/or in the container 98 (Fig. 4), and/or in both (in separate places or in the same place but as separate materials).--

Please replace the paragraph beginning at line 21 of page 17 and ending with line 2 of page 18 with the following amended paragraph.

--A vacuum-insulated catalytic converter by design keeps its inner core or catalyst substrate 27A and 27A' and the inner housing 21A, hot long after the engine has been turned off. To do this, the inner core 27A and 27A', and inner housing 21A, ~~and the inlet and outlet end cones 33A and 43A, end tubes 37A and 47A, and baffles 38A and~~ or bellows 48A, as well as the corresponding elements on the inlet side of the catalytic converter, which couple it to the exhaust system are surrounded by material, such as phase change material (PCM) 129, which stores heat. This heat can then be reabsorbed into the catalytic converter as the converter starts to cool. This PCM material is in turn wrapped with other materials, such as radiation reflector and insulator or multi-layer radiation shield 130, that reflect and insulate. Metal foils are used to reflect the radiant heat back into the core. Because of their low emissivity, nonferrous metals such as copper and aluminum are the foils of choice. Between the layers of foil are layers of insulating material, such as a ceramic material, which keep the metal foil from contacting the layer immediately beneath it and above it. The insulation material 131 is

Applicants : John P. Biel, Jr. et al  
Serial No. : 09/889,646  
Confirmation : 8649  
Atty. Dkt. : BEN02 P-346  
Page : 8

designed to be just wider than the foils 132 with which it is interleaved, to prevent the foils 132 from contacting the other layers of foil 132 along their surface.--

Please replace the paragraph beginning at line 3 of page 18 and ending with line 14 of page 18 with the following amended paragraph.

--The foils 132 and interleaved insulation material 131 are preferably sized such that each strip 130 wraps to make five layers. Each strip width is sized to optimize the coverage needed. Each strip 130 extends in width proportionally until the whole core and inner housing 21A is covered. This is presently accomplished by four strips having overlapping edges, such as at location 134[[133]]. The configuration overlaps and extends in section much like a leaf spring. (See the overlapped area 134 in Fig. 20). With the present design, there are three of these stair-stepped radiation shield configurations used, one strip 130 over the center core and one strip 130A over the bellows at either end of the center core. Each strip 130/130A as it is rolled on is crimped to assist in keeping the wrappings tight and in place as the next strip 130/130A is applied. The final strip 130/130A may be secured with a couple of stainless steel straps 135. Only one strap 135 may be required about each of the bellows.--

Please replace the paragraph beginning at line 22 of page 19 and ending with line 32 of page 19 with the following amended paragraph.

Applicants : John P. Biel, Jr. et al  
Serial No. : 09/889,646  
Confirmation : 8649  
Atty. Dkt. : BEN02 P-346  
Page : 9

--Current designs wrap their radiation shields tightly around the core/inner housing.

This results in continuous conduction between the hot core and the radiation shields, and also makes very small and tortuous paths for hydrogen gas to flow. The novel axial passages shown in Figs. 21-23 provide effective heat transfer by allowing hydrogen gas to freely flow, contact the hot core and transfer heat to the cold jacket. An inlet radiation shield 141'[[141]] and an outlet radiation shield 142 are added to catalytic converter 20D (Fig. 23A) at a location against the baffles 38D and 48D, respectively. An inlet radiation shield 143 and an outlet radiation shield 144 are added to catalytic converter 20D (Fig. 23B) at a location loosely against an inner surface of the outer housing 22D. All radiation shields 140-144 are loosely held by metal straps 135 or other structure (including their own stiffness) for optimal hydrogen flow around them.--

Please replace the paragraph beginning at line 21 of page 20 and ending with line 8 of page 21 with the following amended paragraph.

--An end construction 90HH at the outlet end is particularly constructed to facilitate manufacture of the catalytic converter 20HH and to maintain a very good thermal barrier. The end construction 90HH includes a cylindrical wall extension 91HH that sealingly engages and is brazed to the wall 31HH of the outer housing 22HH. The end construction 90HH further includes a separated and extended outlet tube section 92HH that extends from bellows 48HH.

Applicants : John P. Biel, Jr. et al  
Serial No. : 09/889,646  
Confirmation : 8649  
Atty. Dkt. : BEN02 P-346  
Page : 10

The extended outlet tube section 92HH in effect replaces the inner outlet tube section 46 (Fig. 1) and serves a similar attachment function for connection to an exhaust pipe of the vehicle.

First and second extended cone sections 93HH and 94HH extend from the wall extension 91HH. The cone sections 93HH and 94HH have ring-shaped inner ends that overlap onto each other and onto the wall extension 91HH to form a rigid, sealed connection to the outer housing 22HH221HH. The cone sections 93HH and 94HH have outer ends that are spaced apart from each other and that engage opposing ends of the extended outlet tube section 92HH. The cone sections 93HH and 94HH hold the outlet tube section 92HH in alignment with the bellows 48HH at an end of the bellow 48HH. The inner (i.e. second) cone section 94HH includes spokes or vacuum communication ports instead of comprising a continuous funnel-shaped member, but the first (i.e. outer) cone section 93HH is continuous and funnel-shaped so that the vacuum can be held in the cavity 26HH. The combination of the spokes 50HH and the cone sections 93HH and 94HH at the outlet end of the catalytic converter 20HH provide a very stable and sturdy structure, yet one which is highly thermally insulated.--

Please replace the paragraph beginning at line 19 of page 21 and ending with line 2 of page 22 with the following amended paragraph.

--The catalytic converter 20II (Figs. 25 and 26) includes an outlet end section similar to that of catalytic converter 20HH, but the catalytic converter 20II includes a vacuum

Applicants : John P. Biel, Jr. et al  
Serial No. : 09/889,646  
Confirmation : 8649  
Atty. Dkt. : BEN02 P-346  
Page : 11

maintenance device [[32II']]32II that includes getter material for maintaining a high vacuum in the cavity 26II. Alternatively, or at the same time, the vacuum maintenance device [[32II']]32II may include hydride material for passively increasing the amount of hydrogen gas within the cavity 26II when the inner housing 21II heats up. By increasing hydrogen gas at high temperature, the insulative value of the vacuum cavity 26II is reduced, thus helping throw off and helping to prevent overheating of the catalytic converter 20II. By reducing hydrogen gas at low temperature, the insulative value of the vacuum cavity 26II is increased, thus assisting in faster heat up of the catalyst in the catalytic converter 20II during initial engine starts. Notably, the device [[32II']]32II is positioned relatively close to the inlet or outlet tube section 92II such that it quickly receives heat from hot gases passing through the catalytic converter 20II. These hot gases are indicative of the temperature of the catalyst material in the catalytic converter 20II. As a result, the device [[32II']]32II is able to quickly respond to actual temperature conditions of the catalytic material, which can be important to good operation.--

Please replace the paragraph beginning at line 31 of page 22 and ending with line 17 of page 23 with the following amended paragraph.

--The hydride and/or the getter material of device 32II is located on an inside of the body of the frustoconically-shaped member 101II. Notably, the frustoconically-shaped

Applicants : John P. Biel, Jr. et al  
Serial No. : 09/889,646  
Confirmation : 8649  
Atty. Dkt. : BEN02 P-346  
Page : 12

member 101II is separated from inner and outer housings 21II and [[22I]]22II of the catalytic converter 20II and related components during the bake-out. By directing the heat of the bake-out at the inner and outer housings 21II and 22II and at the related components of that subassembly (and by keeping the subassembly that includes the hydride and getter materials at a cooler lower temperature), the properties and characteristics of the hydride and getter material are preserved so that they are not wasted. (i.e. The hydrogen in the hydride is not prematurely driven off, and the gas sorbing capacity of the getter is not prematurely used up.) Once the subassembly of the frustoconically-shaped member 101II is brought into engagement with the ring flanges 102II and 103II, additional heat is applied to the assembly to melt the brazing material 105II and 106II. It is noted that this additional heat may activate the getter material, but this is not a problem since the bake-out has already occurred and the cavity 26II is under vacuum. Thus, when the getter material cools and become active, it merely begins doing its intended job, which is to absorb gas to maintain the high vacuum. It is noted that this additional heat may activate the hydride material, but this is not a problem since, as noted above, the bake-out has already occurred and the cavity 26II is sealed. Thus the hydride material merely begins doing its intended job, which is to release hydrogen into the cavity 26II when the hydride is at an elevated temperature.--

Applicants : John P. Biel, Jr. et al  
Serial No. : 09/889,646  
Confirmation : 8649  
Atty. Dkt. : BEN02 P-346  
Page : 13

Please replace the paragraph beginning at line 26 of page 23 and ending with line 16 of page 24 with the following amended paragraph.

--The process of bake-out (Fig. 27) includes positioning the main subassembly of the catalytic converter 20II (i.e. that portion including the inner and outer housings 21II and 22II, and the catalytic material or catalyst substrate 27II and 27II', and other components) and positioning the end construction (i.e. that portion including the frustoconically-shaped member 101II, and the vacuum maintenance device 32II) in an enclosed machine chamber 110II. The chamber 110II is closed at one end by an end cover 111II and at its other end by a second end cover 112II that incorporates a turbo pump 113II for drawing a vacuum. Primary induction coils 114II are located around and proximate the outer housing 22II. The primary induction coils 114II are powered to create bake-out temperatures in the range of 450 degrees C. An actuator gripper 115II holds the frustoconically-shaped member 101II at a location axially aligned with the outer housing 22II, but at a location spaced above the outer housing 22II. By this arrangement, the frustoconically-shaped member 101II does not become quickly heated by the primary induction coils 114II, but instead stays at a lower temperature. Thus, the hydride and the getter material in the device [[32II']]32II do not prematurely activate. When the bake-out is completed, the frustoconically-shaped member 101II is lowered in direction "A" onto the inner and outer housings 21II and 22II, such that the "in" flange 102II engages brazing material 105II on the flange 99II, and the "out" flange 103II engages the brazing material

Applicants : John P. Biel, Jr. et al  
Serial No. : 09/889,646  
Confirmation : 8649  
Atty. Dkt. : BEN02 P-346  
Page : 14

106II on the flange 100II. The actuator gripper 115II includes secondary induction coils 116II that are arranged and located to melt the brazing material 105II and 106II to seal the vacuum in the cavity 26II of the catalytic converter 20II. Upon the brazes cooling and solidifying, the chamber is vented to atmosphere and part removed. The reversible getter is activated by exposure to a heat source for some time.--

Please replace the paragraph beginning at line 5 of page 25 and ending with line 23 of page 25 with the following amended paragraph.

--Particulate trap 160JJ is similar to the converter structure or catalytic converter 20 in that the particulate trap 160JJ includes inner and outer housings 21JJ and 22JJ spaced apart to define a vacuum cavity 26JJ around the inner housing 21JJ. The inner and outer housings 21JJ and 22JJ include inlet and outlet ends where exhaust is received and emitted, respectively. An intermediate housing 60JJ holds PCM material adjacent the inner housing 21JJ. Getter material is provided to maintain the vacuum in the cavity 26JJ for a long service life. Hydride materials are provided to emit hydrogen once an operating temperature is achieved, so that the particulate trap does not overheat. Radiation shields 72JJ are wrapped loosely around the intermediate housing 60JJ for reflecting heat energy to prevent undesired heat loss. It is to be understood that the cavity 26JJ can be actively or passively thermally managed. A particulate trapping mechanism 161JJ is positioned within the inner housing 21JJ and potentially includes

Applicants : John P. Biel, Jr. et al  
Serial No. : 09/889,646  
Confirmation : 8649  
Atty. Dkt. : BEN02 P-346  
Page : 15

a regeneration method of fuel fired thermal assist or fuel additive chemical assist to promote complete burning of the carbon particles and soot found in diesel exhaust. The particulate trapping mechanism 161JJ is specifically designed for particular circumstances and operating parameters, such as for emissions expected from a particular engine size and transmission combination. It is contemplated that the excellent insulating properties of the present vacuum insulation structures will help substantially reduce the weight and size of particulate traps

160JJ.--